Gradient Driven Fluctuations Experiment (GRADFLEX)

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Engineering Team: ESA flight hardware contractors

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Objective:

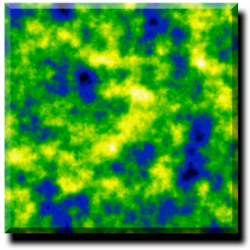
- Study gradient driven-density and concentration fluctuations that are strongly enhanced in fluids by the absence of gravity.
- Achieve a quantitative understanding of gradient driven fluctuations, both on Earth and in the microgravity environment provided during a Foton-M3 mission.

Relevance / Impact:

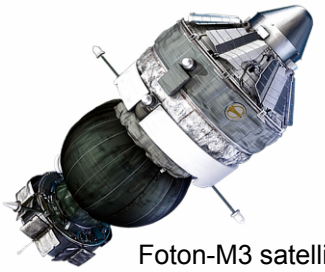
- In reduced gravity, gradients drive giant fluctuations that may impact processes such as crystal growth.
- This experiment was featured on the front-cover of the April 1, 2006 issue of *Applied Optics*.
- The GRADFLEX flight images visually support theoretical predictions by showing a very large increase in the size of the fluctuations in reduced gravity. Data analysis has also shown the amplitude of the fluctuations in temperature and concentration to be greatly increased.

Development Approach:

- GRADFLEX features two samples, one a single-component fluid of a 3 mm thick layer of carbon disulphide (single-component), and the other a 1 mm thick layer of 1.8 wt. % polystyrene (Molecular Weight 9000) in toluene (mixture). These samples are representative of any single-component fluid or mixture. The samples were driven out of equilibrium by applying temperature differences across the layers; 20 Kelvin for the mixture and up to 30 Kelvin for the single-component fluid.
- ESA / ESTEC is funding the flight hardware and provides ground-based support in Italy.
- NASA funding allowed the development of essential prototype hardware and provides ground-based support in the U.S.



Gradient driven fluctuations visible with a shadowgraph



Foton-M3 satellite

ISS Resource Requirements

Accommodation (carrier)	Foton-M3 satellite
Upmass (kg) (w/o packing factor)	55
Volume (m^3) (w/o packing factor)	0.11
Power (kw) (peak)	0.157
Crew Time (hrs) (installation/operations)	None

Project Life Cycle Schedule

Milestones	**PRR**	**SRR**	**PDR**	**CDR**	**TRR**	**FAR**	**FRR**	**Launch**	**Ops**	**Return**	**Final Report**
Actual/ Baseline	30 Jun 03	24 Mar 04	28 Jul 04	20 Jan 06	Sep 2006	Mar 2007	July 2007	14 Sep 2007	Sep 2007	23 Sep 07	Sept 2009
Documentation	Website: eRoom:				SRD: EDMP:			Project Plan: SEMP:			